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ANNUAL PROGRAM ANALYSIS OF THE NASA SPACE LIFE SCIENCES RESEARCH AND EDUCATION SUPPORT PROGRAM

December 1, 1993 - November 30, 1994

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FOREWORD

The Annual Program Analysis of the NASA Space Life Sciences Research and Education Support Program reflects the tasks and manner of compliance of the Universities Space Research Association (USRA) Division of Space Life Sciences under Contract NAS9-18440. This report covers the period from December 1, 1993 through November 30, 1994.

The Director of USRA's Division of Space Life Sciences is Alfred C. Coats, M.D. Deputy Director is Mr. John R. Sevier. Ms. Terri Jones is Project Manager.

INTRODUCTION

History

USRA's Division of Space Life Sciences (DSLS) was established in 1983 as the Division of Space Biomedicine to facilitate participation of the university community in biomedical research programs at the NASA Johnson Space Center (JSC). The DSLS is housed in the Center for Advanced Space Studies (CASS), sharing quarters with the Division of Educational Programs, the Lunar and Planetary Institute, and the Exploration Science Institute. The DSLS provides visiting scientists for the Johnson Space Center; organizes conferences, workshops, meetings, and seminars; and, through subcontracts with outside institutions, supports NASA-related research at more than 25 such entities.

The broad-based research and educational programs of the DSLS encompass the following areas:

- Barophysiology
- Biomedical Engineering
- Biomedical Ethics
- Biostatistics
- Biotechnology
- Bone and Muscle Physiology
- Cardiovascular Physiology
- Cell Culture
- Computer Modeling of Physiological Systems
- Environmental Health
- Exercise Physiology
- Exobiology/CELSS
- Human Factors
- Immunology
- Life Sciences Administration
- Life Sciences Education
- Neuroscience
- Pharmacology
- Radiation Sciences

The DSLS has considerable experience providing visiting scientists and consultants to work in concert with NASA Life Sciences researchers to define research missions and goals and to perform a wide variety of research administration and program management tasks. There are currently 36 visiting scientists and consultants (see Appendix I) working under the auspices of the DSLS. Since the inception of the DSLS, some 70 scientists have received research support through the DSLS, either while in residence in Houston or for projects carried out at their home institutions. More than 500 scientists from approximately 100 universities and other nongovernmental institutions have participated directly in related activities such as topical workshops, advisory groups, seminars, and educational activities.

Objectives of the Contract

The basic objectives of this contract are to stimulate, encourage, and assist research and education in the NASA life sciences. Scientists and experts from a number of academic and research institutions in this country and abroad are recruited to support NASA's need to find a solution to human physiological problems associated with living and working in space and on extraterrestrial bodies in the solar system.

Implementation of the Contract

To fulfill the contract objectives, a cadre of staff and visiting scientists, consultants, experts, and subcontractors has been assembled into a unique organization dedicated to the space life sciences. This organization, USRA's Division of Space Life Sciences, provides an academic atmosphere, provides an organizational focal point for science and educational activities, and serves as a forum for the participation of eminent scientists in the biomedical programs of NASA.

Purpose of This Report

The purpose of this report is to demonstrate adherence to the requirement of Contract NAS9-18440 for a written review and analysis of the productivity and success of the program. In addition, this report will make recommendations for future activities and conditions to further enhance the objectives of the program and will provide a self-assessment of the cost performance of the contract.

RELATIONSHIP TO OTHER NASA EFFORTS

Overview of USRA

The Universities Space Research Association is a private, nonprofit corporation that was organized in 1969 by the National Academy of Sciences at the request of NASA. Upon incorporation, the Association was vested in a consortium of 49 universities. That consortium now consists of 78 member universities. Last year, 1,367 individuals from 286 universities and 87 individuals representing industry participated in USRA-sponsored programs and activities.

USRA provides a mechanism through which universities can cooperate effectively with one another, with the Government, and with other organizations to further space science and technology, and to promote education in these areas. Its mission is carried out through some 13 institutes, centers, divisions (such as the Division of Space Life Sciences), and programs located across the nation. Most of USRA's activities are funded by grants and contracts from the National Aeronautics and Space Administration.

Established Networks with the Scientific Community

For more than two decades, USRA has fostered harmonious and productive collaborations among USRA, the federal government, and the scientific community. USRA's success in responding to the scientific requirements of the Government is largely due to its capability to attract top quality scientists both from within the United States and abroad.

The DSLS has many resources from which to draw upon to identify scientific talent in specific discipline areas. In addition to the network established through USRA's seventy-eight member universities and science councils, the DSLS has established a Space Life Sciences Consortium which consists of 41 academic institutions (37 in the United States). These academic institutions have agreed to join the Consortium for the purpose of collaborating in space life sciences research. Universities that are members of this Consortium are listed in Appendix IV. The DSLS maintains communications with the Consortium through informal discussions, participation in meetings and seminars, and a quarterly newsletter.

Foreign Visitors Exchange Program

Due to its nonprofit status, USRA has an established foreign exchange program with the United States Information Agency. This foreign exchange program allows the DSLS to bring to NASA foreign visitors under the J-1 visa program with the Immigration and Naturalization Service. The DSLS prepares the necessary forms for obtaining J-1 visas and coordinates with NASA Security to obtain the necessary security clearances and badging for foreign visitors.

RESEARCH AREAS

The DSLS has developed a multipronged strategy to achieve its primary objectives of stimulating, encouraging, and assisting research and education in the NASA life sciences. Visiting and staff scientists - experts in a wide variety of discipline areas - are enlisted to spend from one to approximately three years at a NASA facility on projects of mutual interest to the scientists and the sponsoring laboratories. Specific research requirements, such as hardware design and software development, are filled by consultants, who are also recognized experts in their fields. Communication between NASA scientists and the academic community as a whole is facilitated by DSLS-sponsored seminars, conferences, and workshops. Outside academic input into space life sciences is also facilitated by DSLS-administered *ad hoc* investigative and policy-making committees. Finally, some NASA research needs are best filled by scientists working in their home institutions. In those instances, the DSLS has secured subcontracts that support NASA-funded research carried out at nongovernmental academic institutions.

Discipline Areas

The environment created by space flight causes adverse physiological changes in a wide variety of systems. Understanding and devising methods of counteracting these changes thus requires a research program encompassing many different disciplines. To meet this need, the DSLS program is extremely broad-based, encompassing the following disciplines:

- Barophysiology
- Biomedical Engineering
- Biomedical Ethics
- Biostatistics
- Biotechnology
- Bone and Muscle Physiology
- Cardiovascular Physiology
- Cell Culture
- Computer Modeling of Physiological Systems
- Environmental Health
- Exercise Physiology
- Exobiology/CELSS
- Human Factors
- Immunology
- Life Sciences Administration
- Life Sciences Education
- Neuroscience
- Pharmacology
- Radiation Sciences
- Software Development

Visiting and Staff Scientists

Visiting and staff scientists are invited for one to three years, usually to facilitate research collaboration between an outside academic institution and NASA. Typically, a Visiting Scientist either fills a specific NASA research need, or has specialized expertise not available at NASA. Occasionally a visiting scientist will engage in a project of his/her own that complements NASA's ongoing research. Staff Scientists are longer term appointees who typically assist with ongoing administrative tasks in addition to carrying out long-term research projects. Current USRA DSLS Visiting and Staff Scientists are listed in Appendix I.

The DSLS recently completed a successful recruiting effort for a new JSC Human Research Facility (HRF) Visiting Scientist Program. Over 40 highly qualified scientists applied for the two positions offered by the program.

Consultants

From time to time, NASA life science needs require the assistance of scientific experts for short-term assignments such as fulfilling specific research project requirements or developing specific flight hardware items. Through consulting arrangements, the DSLS is able to provide such assistance. All DSLS consultants (listed in Appendix I) sign a consulting agreement before beginning their work for USRA. After completing the assigned task, the consultant submits an invoice voucher to the Project Manager for approval and processing.

Honoraria

The DSLS has in place a mechanism for paying honoraria for such special services as the presentation of papers at conferences, symposia, workshops, meetings, or seminars; for services on *ad hoc* investigative, review, or policy-making committees; and for limited short-term scientific support. This system offers NASA life sciences the talents of distinguished scientists on an occasional short-term or one-time basis. Appendix III lists scientists who have received DSLS honoraria during the last year.

Subcontracts

Some NASA research needs are best met by an arrangement that includes a scientist plus his/her home institution or laboratory. This arrangement, defined in a subcontract between the DSLS and the home institution, affords NASA the opportunity to utilize the scientist's expertise on a relatively short-term basis for a specific task or project, while the home institution receives outside support for its employee and the prestige of collaboration with NASA. Likewise, the scientist benefits by retaining his permanent position and tenure with his home institution while he/she is also able to forge a collaboration with NASA. USRA has found that such an arrangement enhances participation in the scientific community by universities. The DSLS has extensive experience initiating and managing subcontracts supporting NASA-funded research carried out at nongovernmental academic institutions. Appendix II shows the diversity, both in discipline and geographic areas, of the subcontracts administered by the DSLS.

Research Facilities

The DSLS is housed in the Center for Advanced Space Studies (CASS), 3600 Bay Area Boulevard, Houston, Texas, 77058-1113. CASS is home to the Lunar and Planetary Institute, the Exploration Science Institute, and the Division of Educational Programs as well as the DSLS. The Institutes and Divisions share access to a computing center, an image-processing facility, an extensive library, publishing services, and facilities for workshops and conferences. A 185-seat lecture hall is used extensively for Space Medicine Grand Rounds and other seminars. CASS is represented with a homepage on World Wide Web linked to the NASA Headquarters homepage. Internet users can log on to CASS to get on-line information about upcoming meetings or send mail requesting more information to: DSL@CASS.jsc.nasa.gov

SPECIAL PROGRAMS

Human Research Facility (HRF) Visiting Scientist Program

The DSLS recently completed a successful visiting scientist recruitment program for the new Human Research Facility (HRF) at the Johnson Space Center. The program brings established life scientists to work onsite in JSC laboratories for three months to one year on projects of mutual interest to the visiting scientists and sponsoring laboratory. The program emphasizes life science research of operational significance with the objective of expanding the scope of NASA interaction with the academic community. DSLS's promotional program generated over 40 qualified applicants from whom two were selected. John Hoyer, M.D., will collaborate with Dr. Peggy Whitson in the Regulatory Physiology Laboratory on the subject of renal stone formation during space flight, while John Schreiber, M.D., will work with Dr. Duane Pierson in the Microbiology Laboratory, investigating the effects of microgravity on the host response to T-independent bacterial polysaccharides.

NASA/UTMB Space Medicine Fellowship Program

In 1992 a two-year postdoctoral fellowship in space medicine was established as a joint undertaking between the University of Texas Medical Branch in Galveston (UTMB) and the NASA/Johnson Space Center. The DSLS was asked to provide major administrative support for this program, which is managed by an Executive Committee consisting of one member each from JSC, UTMB, and DSLS. The first year's program emphasizes didactic and clinical activities, while the second year emphasizes research and the writing of a thesis. The program accepts two Fellows each year. Since there is no comparable postdoctoral medical fellowship program emphasizing space medicine, and since the Johnson Space Center's specialization in human aspects of space flight gives it unique resources to support this program, the JSC/UTMB Space Medicine Fellowship Program has already received national recognition.

SPECIAL ACTIVITIES

Symposia

The National Space Grant College and Fellowship Program Space Life Sciences Symposium was held May 22-25, 1994 at CASS. The SLS Symposium offered university attendees the opportunity to exchange information on research and educational activities in the life sciences. The DSLS performed extensive administrative planning and coordination for the Symposium. Some 150 attendees from colleges and universities across the nation and from industry attended the Symposium to hear NASA discipline scientists explain their research and discuss how collaborative relationships are formed.

Workshops and Working Groups

Topical workshops are an excellent means of involving the larger academic community in problems of interest to NASA life sciences investigators, and working group meetings allow participants to complete specific tasks and agenda items. The DSLS has extensive experience supporting both types of meetings and CASS facilities offer groups of 50 to 100 people ample accommodations for both splinter and plenary sessions. Working groups can use CASS computer facilities to produce documents and protocols. Support for these workshops can also include issuing invitations, publishing abstracts, making travel arrangements, purchasing meeting supplies, planning agendas, and other logistical support.

Examples of workshops and working groups supported by DSLS in 1994 include:

5th Annual Space Radiation Health Investigators' Meeting, CASS, 4/26-28/94.

Teacher Review Team Meeting, *Human Physiology in Space*, Dallas, 7/29-30/94.

Joint Mission Science Working Group, CASS, 8/29-9/2/94.

Environmental Sensors Workshop, CASS, 9/22-23/94.

US/Russian Joint Working Group, CASS, 10/17-20/94.

Meetings

Meetings in support of NASA life sciences research are often held at CASS. Support for these meetings, as well as for those scheduled at other locations in and around JSC or in locations across the country, can include issuing invitations, making travel arrangements, purchasing meeting supplies, planning agendas, and other logistical support.

Meetings supported during the last year include:

Food Microbiology Meeting, CASS, 12/1-2/93.

Life Sciences Concurrent Engineering, CASS, 12/3/93.

Biotechnology Facility Meeting, CASS, 12/6-10/93.

Common Sense Approach to Grant Writing, CASS, 12/9/93.

Telemedicine Meeting, Washington, D.C., 12/13-14/93.

Iowa State/NASA/JSC Meeting, CASS, 12/16/93.

Microbiology Retreat, CASS, 12/21/93.

Common Sense Approach to Grant Writing, CASS, 1/7/94.

Rhesus Biocosmos Meeting, Paris, France, 2/17-18/94.

Space Medicine Fellowship Interviews, CASS, 2/18/94.

Biotechnology Facility Meeting, CASS, 2/24/94.

GASMAP Critical Design Review, CASS, 3/1-2/94.

SMSP Instrument Advisory Group, CASS, 3/7-8/94.

Centrifuge Facility *Ad Hoc* Review Panel, Washington, D.C., 5/3-5/5/94.

Animal Use and Care *Ad Hoc* Review Panel, Washington, D.C., 5/31/94.

Working with Russians, CASS, 5/26-31/94.

Italian Space Agency, CASS, 5/31/94.

Space Medicine Fellowship Orientation for New Fellows, CASS, 7/5/94.

Working with Russians, Regents Park III, 7/21, 22, 25, 26/94.

Negotiating with Russians, Regents Park III, 7/28-29/94.

OLMSA, Johnson Space Center, Kennedy Space Center, Ames Research Center,
7/31-8/3/94.

Negotiating with Russians, CASS, 8/24/94.

Cross Cultural Meeting of Astronauts/Cosmonauts, JSC 4S, 10/10-14/94.

GASMAP Critical Design Review, CASS 11/30-12/2/94.

Seminars

Seminars are an integral part of a good scientific research environment. They provide timely communication of scientific results long before data can be published, provide communication of data that may never be published but may provide important information nonetheless, promote multidisciplinary understanding of problems and their potential solutions; encourage researchers to organize and present their data, provide a forum for critical peer reviews, and provide an opportunity for in-house scientists to consult with the guest speakers. DSLS involvement in these seminars can include issuing invitations to potential speakers, arranging for their travel, publicizing the seminar, and scheduling appointments for the seminar speaker to meet JSC discipline scientists and laboratory heads.

Seminars supported during 1994 include:

An Examination of the Role of Biophysical Phenomena in Cardiovascular Response to Weightlessness: An Update on the "Hearts in Space" KC-135 Parabolic Flight Experiments, George Pantalos, Ph.D., Departments of Surgery and Bioengineering, University of Utah, and M. Keith Sharp, Ph.D., Department of Civil Engineering, University of Utah, 1/28/94, JSC Conference Rooms.

Adaptation to Repeated Stress: Protective Cross Effects, F. Z. Meerson, M.D., President, International Society of Adaptive Medicine, Moscow, Russia, 2/4/94, CASS.

Adaptation to Intermittent Hypoxia: Protective Cross Effects, F. Z. Meerson, M.D., President, International Society of Adaptive Medicine, Moscow, Russia, 2/4/94, CASS.

Sleep Deprivation, Vigilance Deficits, and the Brain: Relevance for Long-Term Exposure to Microgravity, Ralph Lydic, Ph.D., Department of Anesthesia, Pennsylvania State University College of Medicine, Hershey, PA, 3/28/94, JSC Conference Rooms.

Modeling and Simulation of Human Bone Structures, Catherine G. Ambrose, Ph.D., Assistant Professor, Timothy P. Harrigan, Associate Professor, Frances B. Biegler, Senior Research Assistant, University of Texas Medical School Orthopaedic Biomechanics Laboratory, Houston, TX, 4/29/94, JSC Conference Rooms.

Role of Exercise in the Prevention and Reversal of Disuse Osteopenia, Sue Bloomfield, Ph.D., Texas A&M University, Department of Health & Kinesiology, College Station, TX, 8/15/94, JSC Conference Rooms.

Space Medicine Grand Rounds

Grand Rounds for the newly-established Space Medicine Fellowship Program has proven to be a most productive dividend for both NASA/Johnson Space Center and the University of Texas Medical Branch, co-sponsors of the Fellowship. The seminars are presented approximately once each month and alternate between the CASS Lecture Hall and the Shriners Hospital Auditorium at UTMB. The Grand rounds have afforded both the NASA life sciences community and the medical community easy access to productive information exchange. DSLS participation in Space Medicine Grand Rounds includes publicizing the seminar and arranging for transportation from NASA to UTMB.

The following Space Medicine Grand Rounds were presented in 1994:

Reproductive Considerations for Space Flight, Richard T. Jennings, M.D., Chief, Flight Medicine Clinic, NASA/Johnson Space Center, 12/7/93, Shriners Hospital.

Vestibular Adaptation to Altered Gravito-Inertial Environments, Adrian Perachio, Ph.D., Professor, Departments of Otolaryngology, Physiology & Biophysics, and Anatomy & Neurosciences, University of Texas Medical Branch, Galveston, 1/12/94, CASS.

The Mapping of Mars, Hans Mark, Ph.D., Professor of Aerospace Engineering and Engineering Mechanics, University of Texas at Austin, 2/16/94, Shriners Hospital.

Effect of Radiation on Long-Duration Human Space Exploration, Michael Stanford, Ph.D., Senior Research Scientist, Houston Advanced Research Center, 3/23/94, CASS.

Development of Exercise Countermeasures for Space Flight, Suzanne Fortney, Ph.D., Cardiovascular Physiologist, NASA Space Biomedical Research Institute, 4/19/94, Shriners Hospital.

Wintering Over in the Antarctic: A Physician's Experience, Matt Houseal, M.D., Emergency Medicine Physician/Psychiatrist, Texas Tech University Medical School, 5/25/94, Shriners Hospital.

Star Trek: All the Right Stuff, Majel Barrett Roddenberry, Actress and widow of Star Trek Creator Gene Roddenberry, 7/13/94, Levy Hall.

Updates in Space Medicine, Arnauld E. Nicogossian, M.D., Deputy Associate Administrator, NASA, Office of Life and Microgravity Sciences and Applications, 7/21/94, CASS.

Models of Decompression Sickness, Michael L. Gernhardt, Ph.D., NASA Astronaut, 9/29/94, CASS.

Travel Arrangements

Making travel arrangements for visiting scientists, consultants, and meeting attendees is another facet of DSLS administrative work.

Additional travelers during the year included:

Damien Simon, NASA/JSC, 1/18/94.

Ron Merrell, Russia, 1/27-29/94

CO² Study Investigator Meeting, Cologne, Germany, 3/10-11/94

US/Russian Bio Project Meeting, Moscow/Paris, 3/5-18/94.

Michael Smith, Ph.D., NASA/JSC, 6/7-14/94.

M. M. Wiederhold to IML-2 Meeting, Huntsville, AL, 6/16-17/94.

Michel-Ange Amorim, NASA/JSC, 6/20-6/24/94.

Michael Smith, Ph.D., NASA/JSC, 6/22-7/1/94.

George Pantalos, Ph.D. and Steve Parnis, NASA/JSC for KC-135 flight, 6/27-7/1/94.

Robert W. Phillips, Washington, D.C., 7/9-9/9/94.

Cospar Meeting, Germany, 7/10-7/21/94.

Dr. Edward Thomas, NASA/JSC, 10/12-16/94.

Drs. Herman Vandenburg and Jeffrey Alberts, NASA/JSC, 10/18-20/94.

PUBLICATIONS

Update of Human Physiology in Space: A Program for America

A modified and enhanced version of this textbook has been produced and is currently being printed through the U.S. Government Printing Office. *Human Physiology in Space: A Program for America* was developed under the direction of DSLS Visiting Scientist Barbara Lujan and sponsored by NASA, the National Institutes of Health (NIH), USRA, and the University of Texas Southwestern (UTSW) Medical Center in Dallas.

The materials, which were prepared as a supplement to a high school biology, health science, or physiology curriculum, present elements of the emerging fields of space physiology and space biology at a level that can be clearly understood by students in this age group. The textbook is produced in both a Teacher's and a Student's version. A multidisciplinary approach, utilizing the principles of biology, chemistry, physics, and mathematics, is used to describe how the human body functions and how it changes and adapts to the environmental differences encountered in space. The lessons are built around the results of actual space flight experiments that have been carried out on the space shuttle in recent years.

The textbook is featured in a demonstration project to take place in about 50 high school classrooms in the Dallas/Ft. Worth area during the spring of 1995. Input from these teachers and those teachers from New Mexico who took part in the text's first edition classroom pilot project has been incorporated into this new edition.

Research Articles

DSLS Visiting Scientists published the following articles in refereed journals, books, and reports during the last year:

Charles, J.B. and **Lathers, C.M.**: Summary of lower body negative experiments during space flight. *J Clin Pharmacol* 34:571-583, 1994.

Frey, M.A., **Lathers, C.M.**, Davis, J., Fortney, S., Riddle, J., Steinmann, L., and Charles, J.B.: Hydration state and the cardiovascular response to the stand test. *J Clin Pharmacol* 34:387-393, 1994.

Isbert, J., Crawford, H.J., Engelage, J., Guzik, T.G., Hollier, M., Lindstrom, P.J., Mitchell, J.W., Neuhaus, J., **Schimmerling, W.**, Simon, M., and Wefel, J.P.: Fragmentation cross sections for use in GCR propagation calculations. *Proceedings International Cosmic Ray Conference, Calgary, 1993*. In press.

Lathers, C.M. and Charles, J.B.: Comparison of echocardiographic data using 50° head-down tilt and space flight. *J Clin Pharmacol* 34:489-499, 1994.

Lathers, C.M. and Charles, J.B.: Mechanisms of and treatment for orthostatic intolerance in patients, bed rest subjects, and astronauts. *J Clin Pharmacol* 34:403-417, 1994.

Lathers, C.M. and Charles, J.B.: Use of lower body negative pressure to counter symptoms of orthostatic intolerance in patients, bed rest subjects, and astronauts. *J Clin Pharmacol* 33:1071-1085, 1993.

Lathers, C.M., Charles, J.B., Mukai, C.N., Riddle, J.M., Jacobs, F., Bennett, B.S., Lewis, D., Fortney, S., Frey, M.A., Stricklin, M.D.: Use of lower body negative pressure to assess changes in orthostatic heart rate response during 17 weeks of bed rest. *J Clin Pharmacol* 34:563-570, 1994.

Lathers, C.M., Charles, J.B., Putcha, L.: The 12th Frontiers Symposium: "Pharmacology Beyond Earth's Boundaries." *J Clin Pharmacol* 34:361-362, 1994.

Lathers, C.M., Riddle, J.M., Mulvagh, S.L., Mukai, C., Diamandis, P.H., Dussack, L.G., Bungo, M.W., and Charles, J.B.: Echocardiography during six hours of bed rest at head-down and head-up tilt: Comparison to space flight. *J. Clin Pharmacol* 33:535-543, 1993.

Mukai, C.N., **Lathers, C.M.**, Charles, J.B., Bennett, B.S., Igarashi, M., Patel, S.: Cardiovascular responses to repetitive exposure to hyper- and hypogravity states produced by parabolic flight. *J Clin Pharmacol* 34:472-479, 1994.

Robbins, D., Petrov, V., and **Schimmerling, W.**: *Chapter 14. Risks to humans from ionizing space radiation.* FOUNDATIONS OF SPACE BIOLOGY AND MEDICINE Volume III: MAN IN SPACE FLIGHT , BOOK 2. The effects of other space flight factors. Part IV. Radiation. A. Nicogossian and Y. Grigoriev, Eds. In press.

Schimmerling, W.: The problems of radiations in space. *Radioprotection* 28:173-178, 1993.

Schraeder, P.L., **Lathers, C.M.**, and Charles, J.B.: Spectrum of syncope. *J Clin Pharmacol* 34:454-459, 1994.

Shavers, M.R., Miller, J., Townsend, L.W., Wilson, J.W., and **Schimmerling, W.**: The fragmentation of 670A MeV Neon-20 as a function of depth in water. III. Analytic multigeneration transport theory. *Radiat Res* 136:1-14, 1993.

Wilson, J.W., Nealy, J.E., and **Schimmerling, W.**: Effects of radiobiological uncertainty on shield design for a 60-day lunar mission. NASA Technical Memorandum 4422, February 1993.

Wilson, J.W., Nealy, J.E., **Schimmerling, W.**, Cucinotta, F.A., and Wood, J.S.: Effects of radiobiological uncertainty on vehicle and habitat shield design for missions to the Moon and Mars. NASA Technical Paper 3312, August 1993.

DSLS Visiting Scientists presented the following abstracts during the last year:

Lathers, C.M. and Charles, J.B.: Autonomic nervous system function: evaluation in patients and bedrest subjects (model for weightlessness). *J Clin Pharmacol* 33:770, 1993.

Lathers, C.M. and Charles, J.B.: Orthostatic hypotension in patients, bed rest subjects, and astronauts. *The FASEB Journal* 7: A666, 1993.

Lathers, C.M., Charles, J.B., Schneider, V.S.: Plasma volume (PV) response during 17 wks of bed rest (BR). *The FASEB Journal*, submitted 1994.

Lathers, C.M., Charles, J.B., Mukai, C.N., Riddle, J.M., Jacobs, F.O., Bennett, B.S., Lewis, D., Fortney, S., Frey, M.A., Stricklin, M.D., Schneider, V.S.: Effect of 17 weeks bedrest on cardiovascular parameters during LBNP. *J Clin Pharmacol* 33:769, 1993.

Lathers, C.M., Levin, R.M., Spivey, W.H.: Coronary occlusion effect on myocardial beta receptor density, heart rate, and blood pressure in cats after labetalol treatment for 1, 2, or 8 weeks. *J Clin Pharmacol* 34: 1994.

Lathers, C.M. and Schraeder, P.L.: Clinical Pharmacology Problem Solving (CPPS) Unit: "Clinical pharmacology of antiepileptic drug use, clinical pearls about the perils of Patty." *The FASEB Journal* 8: A3268, 1994.

Miller J., Curtis, S., Frankel, K., Gong, W., Heilbronn, L., Lampo, E., Leres, R., Zeitlein, C., and **Schimmerling, W.**: Ground-based measurements of the fragmentation of high energy iron nuclei in matter. Fourth Annual Space Radiation Health Investigators' Workshop, March 20-21, 1993, Dallas, TX.

Mukai, C.N., **Lathers, C.M.**, Charles, J.B., Bennett, B.S., Igarashi, M., Patel, S.: Cardiovascular responses (CVR) to acute and repetitive hyper- and hypogravity produced by parabolic flight. *J Clin Pharmacol* 33:769, 1993.

Schimmerling, W.: Radiobiologie et l'espace. Colloquium on radiobiologie: aspects biologiques et bases physiocochimiques, July 11-16, 1993, Sherbrooke (Quebec, Canada).

Schraeder, P.L., **Lathers, C.M.**, and Charles, J.B.: Spectrum of syncope. *J Clin Pharmacol* 33:770, 1993.

Wilson, J.W., Thibeault, S.A., Cucinotta, F.A., Kim, M., Kiefer, R., and **Schimmerling, W.**: Effects of shield properties on cell transformation in C3H10T 1/2. 42nd Annual Meeting of the Radiation Research Society, April 29-May 4, 1994, Nashville, TN.

Proceedings

Proceedings of the 12th Frontiers Symposium "Pharmacology Beyond Earth's Boundaries" that was held May 6-8, 1992 at the Center for Advanced Space Studies and cosponsored by The American College of Clinical Pharmacology and USRA Division of Space Life Sciences were published as the May and June 1994 issues of *The Journal of Clinical Pharmacology*. Both peer-reviewed issues were edited by Visiting Scientist Dr. Claire Lathers.

The May 1994 issue of *The Journal of Clinical Pharmacology* included the following articles:

1. Lathers, C.M., Charles, J.B., Putcha, L.: The 12th Frontiers Symposium: "Pharmacology Beyond Earth's Boundaries." *J Clin Pharmacol* 34:361-362, 1994.
2. Taylor, A.A.: Autonomic control of cardiovascular function: Clinical evaluation in health and disease. *J Clin Pharmacol* 34:363-374, 1994.
3. Smith, J.J., Porth, C.M., and Erickson, M.: Hemodynamic response to the upright posture. *J Clin Pharmacol* 34:375-386, 1994.
4. Frey, M.A.B., Lathers, C.M., Davis, J., Fortney, S., and Charles, J.B.: Cardiovascular responses to standing: Effect of hydration. *J Clin Pharmacol* 34:387-393, 1994.
5. Frey, M.A.B., Tomaselli, C.M., and Hoffer, W.G.: Cardiovascular responses to postural changes: Differences with age for women and men. *J Clin Pharmacol* 34:394-402, 1994.

6. Lathers, C.M. and Charles, J.B.: Orthostatic hypotension in patients, bed rest subjects, and astronauts. *J Clin Pharmacol* 34:403-417, 1994.
7. Biaggioni, I., Robertson, R.M., and Robertson, D.: Manipulation of norepinephrine metabolism with yohimbine in the treatment of autonomic failure. *J Clin Pharmacol* 34:418-423, 1994.
8. Inagami, T.: Atrial natriuretic factor as a volume regulator. *J Clin Pharmacol* 34:424-426, 1994.
9. Whitson, P.A., Cintron N.M., Pietrzyk, R.A., Scotto, P., and Loeppky, J.A.: Acute effects of head-down tilt and hypoxia on modulators of fluid homeostasis. *J Clin Pharmacol* 34:427-433, 1994.
10. Fortney, S.M., Turner, C., Steinmann, L., Driscoll, T., and Alfrey, C.: Blood volume responses of men and women to bed rest. *J Clin Pharmacol* 34:434-439, 1994.
11. Simanionok, K.E., Srinivasan, R.S., Myrick, E.E., Blomkalns, A.L., and Charles, J.B.: A comprehensive Guyton model analysis of physiologic responses to preadapting the blood volume as a countermeasure to fluid shifts. *J Clin Pharmacol* 34:440-453, 1994.
12. Schraeder, P.L., Lathers, C.M., and Charles, J.B.: The spectrum of syncope. *J Clin Pharmacol* 34:454-459, 1994.
13. Smith, M.L.: Mechanisms of vasovagal syncope: Relevance to postflight orthostatic intolerance. *J Clin Pharmacol* 34:460-465, 1994.
14. Piwinski, S.E., Jankovic, J., and McElligott, M.A.: A comparison of postspace-flight orthostatic intolerance to vasovagal syncope and autonomic failure and the potential use of the alpha agonist midodrine for these conditions. *J Clin Pharmacol* 34:466-471, 1994.
15. Mukai, C.N., Lathers, C.M., Charles, J.B., and Bennett, B.S.: Cardiovascular responses to repetitive exposure to hyper- and hypogravity states produced by parabolic flight. *J Clin Pharmacol* 34:472-479, 1994.
16. Krutz, R.W., Jr., Sawin, C.F., Stegmann, B.J., and Burton, R.R.: Preinflation before acceleration on tolerance to simulated space shuttle reentry G profiles in dehydrated subjects. *J Clin Pharmacol* 34:480-483, 1994.
17. Tripp, L.D., Jennings, T.J., Seaworth, J.F., Howell, L.L., and Goodyear, C.: Long-duration +Gz acceleration on cardiac volumes determined by two-dimensional echocardiography. *J Clin Pharmacol* 34:484-488, 1994.
18. Lathers, C.M. and Charles, J.B.: Comparison of cardiovascular function during the early hours of bed rest and space flight. *J Clin Pharmacol* 34:489-499, 1994.
19. Leach, C.S., Lane, H.W., and Krauhs, J.M.: Short-term space flight in nitrogenous compounds, lipoproteins, and serum proteins. *J Clin Pharmacol* 34:500-509, 1994.
20. Billica, R.: Medical management of U.S. astronauts. *J Clin Pharmacol* 34:510-512, 1994.
21. McCuaig, K.: Surgical problems in space: An overview. *J Clin Pharmacol* 34:513-517, 1994.
22. Stampi, C.: Sleep and circadian rhythms in space. *J Clin Pharmacol* 34:518-534, 1994.
23. Santy, P.A., Faulk, D.M., and Davis, J.R.: Strategies for the preflight circadian shifting of space shuttle crews. *J Clin Pharmacol* 34:535-542, 1994.

The June 1994 issue of *The Journal of Clinical Pharmacology* included the following articles:

1. Cornelissen, G., Zaslavskaya, R.M., Kumagai, Y., Romanov, Y., Halberg, F.: Chronopharmacologic issues in space. *J Clin Pharmacol* 34:543-551, 1994.
2. Halberg, F., Cornelissen, G., Bingham, C., del Pozo, F., Arredondo, M.T., Otsuka, K., Quadens, O., Breus, T., Rapoport, S., Komarov, F.: Telehygiene system for preventive chronopharmacology in space. *J Clin Pharmacol* 34:552-557, 1994.
3. Butler, G.C., Yamamoto, Y., Hughson, R.L.: Heart rate variability to monitor autonomic nervous system activity during orthostatic stress. *J Clin Pharmacol* 34:558-562, 1994.
4. Lathers, C.M., Charles, J.B., Schneider, V.S., Frey, M.A. B., Fortney, S.: Use of lower body negative pressure to assess changes in heart rate response to orthostatic-like stress during 17 weeks of bed rest. *J Clin Pharmacol* 34:563-570, 1994.
5. Charles, J.B., Lathers, C.M. Summary of lower body negative pressure experiments during space flight. *J Clin Pharmacol* 34:571-583, 1994.
6. Bondar, R.L., Kassam, M.S., Stein, F., Dunphy, P.T., Riedesel, M.L.: Simultaneous transcranial Doppler and arterial blood pressure response to lower body negative pressure. *J Clin Pharmacol* 34:584-589, 1994.
7. Siconolfi, S.F., Charles, J.B., Moore, A.D., Barrows, L.H.: Comparing the effects of two in-flight aerobic exercise protocols on standing heart rates and VO₂ peak before and after space flight. *J Clin Pharmacol* 34:590-595, 1994.
8. Kumar, K.V., Powell, M.R., Waligora, J.M.: Early stopping of aerospace medical trials: Application of sequential principles. *J Clin Pharmacol* 34:596-598, 1994.
9. Cowings, P.S., Toscano, W.B., Miller, N.E., Pickering, T.G., Shapiro, D., Stevenson, J., Maloney, S., Knapp, J.: Autogenic feedback training: A potential treatment for orthostatic intolerance in aerospace crews. *J Clin Pharmacol* 34:599-608, 1994.
10. Reschke, M.F., Bloomberg, J.J., Harm, D.L., Paloski, W.H.: Space flight and neurovestibular adaptation. *J Clin Pharmacol* 34:609-617, 1994.
11. Harm, D.L., Parker, D.E.: Preflight adaptation training for spatial orientation and space motion sickness. *J Clin Pharmacol* 34:618-627, 1994.
12. Wood, C.D., Stewart, J.J., Wood, M.J., Struve, F.A., Straumanis, J.J., Mims, M.E., Patrick, G.Y.: habituation and motion sickness. *J Clin Pharmacol* 34:628-634, 1994.
13. Stewart, J.J., Wood, M.J., Wood, C.D., Mims, M.E.: Effects of motion sickness and antinotion sickness drugs on gastric function. *J Clin Pharmacol* 34:635-643, 1994.
14. Lackner, J.R. and Graybiel, A.: Use of promethazine to hasten adaptation to provocative motion. *J Clin Pharmacol* 34:644-648, 1994.
15. Bagian, J.P. and Ward, D.F.: A retrospective study of promethazine and its failure to produce the expected incidence of sedation during space flight. *J Clin Pharmacol* 34:649-651, 1994.
16. Simanonok, K.E. and Charles, J.B.: Space sickness and fluid shifts: An hypothesis. *J Clin Pharmacol* 34:652-663, 1994.
17. Cheung, B.S.K., Kohl, R.L., Money, K.E., Kinter, L.B.: Etiological significance of arginine vasopressin (AVP) in motion sickness. *J Clin Pharmacol* 34:664-670, 1994.
18. Tietze, K.J. and Putcha, L.: Factors affecting drug bioavailability in space. *J Clin Pharmacol* 34:671-676, 1994.

19. Feldman, S. and Brunner, L.J.: Small animal model of simulated weightlessness for pharmacokinetic evaluation. *J Clin Pharmacol* 34:677-683, 1994.
20. Derendorf, H.: Pharmacokinetic/pharmacodynamic consequences of space flight. *J Clin Pharmacol* 34:684-691, 1994.
21. Srinivasan, R.S., Bourne, D.W.A., Putcha, L.: Application of physiologically based pharmacokinetic (PBPK) models for drug disposition in space. *J Clin Pharmacol* 34:692-698, 1994.
22. Boedecker, B.H., Lojeski, E.W., Kline, M.D., Haynes, D.H.: Ultra-long duration local anesthesia produced by injection of lecithin-coated tetracaine microcrystals. *J Clin Pharmacol* 34:699-702, 1994.
23. Taylor, G.R.: Space Station Freedom Life Sciences Activities. *J Clin Pharmacol* 34:703-708, 1994.
24. Vick, J.A.: Medical studies of the poisonous land and sea snakes. *J Clin Pharmacol* 34:709-712, 1994.
25. Bonner, M.J.: Prenatal and neonatal pharmacologic stress on early behavior and sexual maturation in the hamster. *J Clin Pharmacol* 34:713-7, 1994.

Special Format Publications

Special format publications can serve as valuable adjuncts to conferences and workshops. This year the DSLS compiled and published booklets of abstracts for the Space Radiation Health Investigators' and the Environmental Sensors Meetings, as well as a presentation notebook for participants in the National Space Grant College and Fellowship Program Space Life Sciences Symposium.

SPACE LIFE SCIENCES CONSORTIUM

In late 1990 USRA organized a group of academic institutions with an expressed interest in promoting and enhancing interaction between NASA Space Life Sciences and themselves. The Space Life Sciences Consortium (Appendix IV), as it is called, has grown to 41 members (four outside the U.S.).

University of Alabama in Huntsville	National Institutes of Health
University of Arizona	• National Institute on Deafness & Other
Baylor College of Medicine	Communication Disorders
Boston University School of Medicine	• National Institute of Neurological Disorders and
Brandeis University	Stroke
University of California, Los Angeles	• Office of Science Policy and Legislation
University of California, San Diego	Pennsylvania State University
Case Western Reserve University	RAF Institute of Aviation Medicine (U.K.)
Centre National de la Recherche Scientifique (France)	Rensselaer Polytechnic Institute
Good Samaritan Hospital & Medical Center, Portland, Oregon	Rice University
University of Houston, Downtown	University of Sheffield (U.K.)
University of Houston, Clear Lake	Stanford University
Lehigh University	Texas A&M University System
Los Alamos National Laboratory	Uniformed Services University of the Health Sciences
Massachusetts Institute of Technology	University of Texas, Austin
McGill University (Canada)	University of Texas Health Science Center at Houston
Miami University	University of Texas Health Science Center at San Antonio
Mayo Clinic, Rochester, Minnesota	University of Texas Medical Branch at Galveston
University of Michigan	University of Texas Southwestern Medical Center at Dallas
Michigan State University	Vanderbilt University
University of Minnesota	Wright State University
Mt. Sinai Medical Center	

The first meeting of consortia members was held January 25, 1991 in Houston, TX. Representatives from both the Consortium and from the NASA life sciences community met to develop ideas and to define the Consortium's organizational structure and operation. Both sides expressed enthusiasm over the prospect of a potential "clearing house" for dissemination of information and exchange of personnel.

Consortium Newsletter

Information about NASA life sciences in general, and ongoing space biomedical research and research opportunities in particular, is disseminated in the *Space Life Sciences Quarterly*, published by the DSLS. Members of the Consortium and any others interested in the subject matter have been added to the *Quarterly* distribution list. Recent articles have focused on the JSC Exercise Countermeasures Project, the practice of Space Medicine as a specialty, and differences between life sciences research as supported by NASA and the National Institutes of Health.

DSLS SCIENCE COUNCIL

Each institute, center, division, or program of USRA is overseen by a Science Council that serves, in effect, as a scientific board of directors. Each Science Council provides guidance in the discipline area for which it is responsible. Members are appointed to three-year terms by the USRA Board of Trustees on the basis of their scientific expertise and their standing within the academic community.

Members of the DSLS Science Council include:

Bobby R. Alford, M.D.
(convener)
Baylor College of Medicine
Houston, Texas

James Lackner, Ph.D.
Brandeis University
Waltham, Massachusetts

F. Owen Black, M.D.
Good Samaritan Hospital
Portland, Oregon

M. David Low, M.D., Ph.D.
University of Texas Health Science Center
Houston, Texas

Alfred C. Coats, M.D.
(*ex officio*)
USRA-DSLS and
Baylor College of Medicine
Houston, Texas

Charles Oman, Ph.D.
Massachusetts Institute of Technology
Cambridge, Massachusetts

Michael Holick, M.D.
Boston University School of Medicine
Boston, Massachusetts

Harrison Schmitt, Ph.D.
Albuquerque, New Mexico

Thomas James, M.D.
University of Texas Medical Branch
Galveston, Texas

Scott Swisher, M.D.
Michigan State University (emeritus)
East Lansing, Michigan

CONTRACT INFORMATION

Contract Status

In November 1990, the NASA Lyndon B. Johnson Space Center's Space and Life Sciences Procurement Branch awarded Universities Space Research Association's Division of Space Life Sciences the NASA contract for Space Life Sciences Research and Education Support (NAS9-18440).

The period of performance for contract NAS9-18440 is December 1, 1990 to November 30, 1995. The basic contract value is \$15,234,200 to which may be added five one-year options for incremental increase of effort. The options for incremental increase in effort allow the Government to increase the number of man-hours during any individual 1-year period of performance by an amount ranging from 1 to 25,000 man-hours. The five one-year options added to the basic contract value equal a maximum total contract value of \$22,222,500.

The first year's option to increase the number of man-hours was not exercised; the second year's option to increase man-hours was exercised in October 1992. The third year's option was exercised in March 1993, while the fourth year's option was exercised in June 1994. It is anticipated that the fifth year's option to increase man-hours will be exercised in January 1995. Therefore, the addition of four years of incremental increase in man-hours added to the basic contract value brings the total contract value to \$21,245,950.

Financial Status

Financial Analysis

Figure 1 illustrates actual monthly expenditures for the Division of Space Life Sciences for the period December 1, 1990 through November 30, 1994 along with the funding level through Mod 60 and the contract value with Option 4 exercised. The graph shows that funding has always exceeded expenditures. The contract value appears adequate, especially with the additional value of Option 5, to sustain the division through the end of the contract.

Figure 2 shows the labor hours associated with the DSLS contract since its inception December 1, 1990 through November 30, 1994, along with projections of the labor hours for the remainder of the contract. The DSLS contract is a level of effort contract with 272,050 (through Option 5) total labor hours, plus or minus five percent. The solid line on Figure 2 represents the band of allowable labor hours with each option, and the dashed line represents the total hours plus five percent ceiling. Projections show that the hours status is very close to the total hours ceiling and should allow the Division to operate through the end of the contract (provided no substantial increases in effort are required during the last contract year).

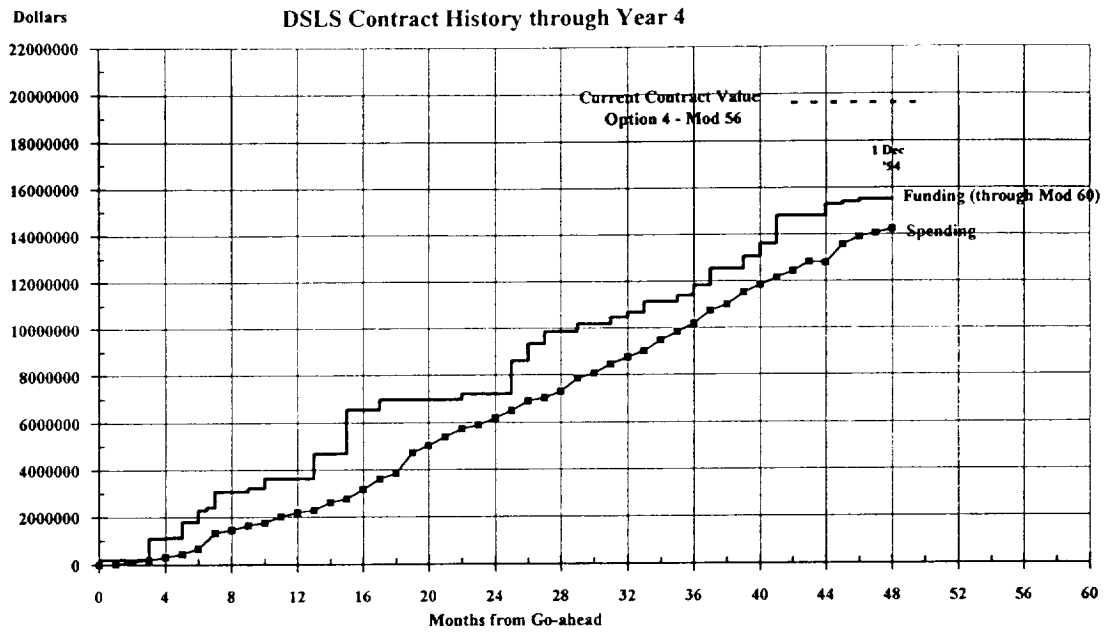


Figure 1

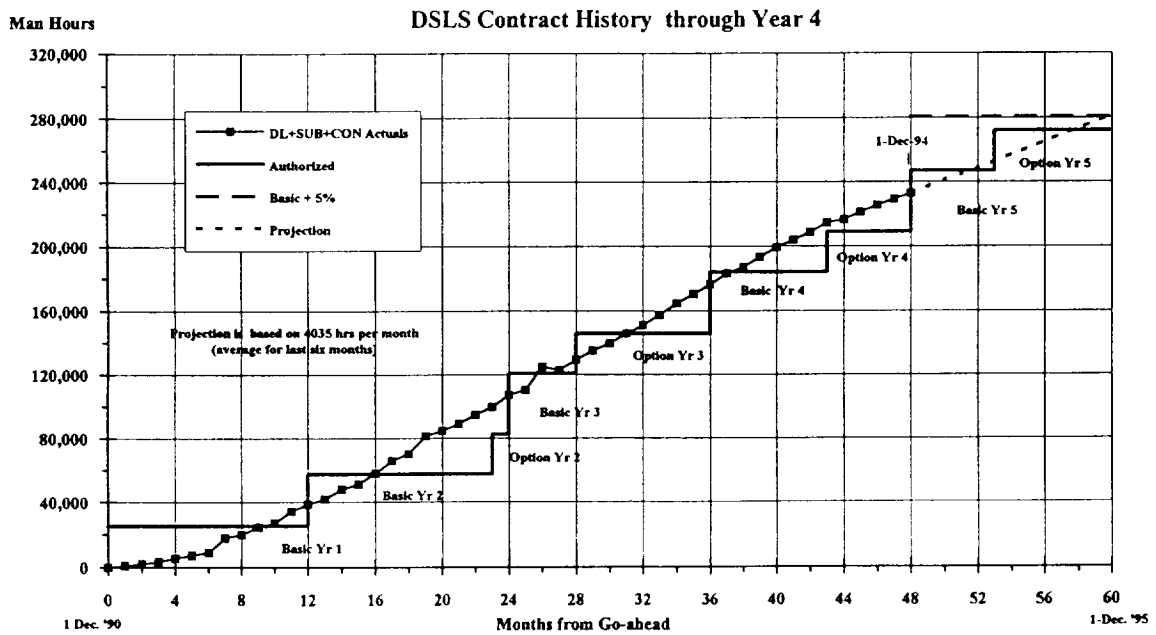


Figure 2

The following cost-by-cost elements will be analyzed:

Reporting Category	Contract Value through Option 4	Cum-to-Date through 11/30/95
Direct Labor Hours	247,050	115,941
Consulting Hours	0	63,921
Subcontractor Hours	0	53,130
Total Hours	247,050	232,991
Direct Labor	\$6,151,827	\$2,595,621
Fringe Benefits	2,531,344	1,056,788
Travel/Subsistence	745,677	1,735,745
Consultant Services	0	2,257,864
Equipment	0	173,422
Subcontracts	2,683,600	3,543,912
Other Direct Costs	3,062,373	655,686
Overhead	1,908,906	926,622
General and Administrative	1,380,046	820,523
Subcontract and Equipment Fee	0	50,531
FCOM	787,190	167,868
Management Fee	354,486	277,066
Program Income	0	(39,051)
TOTAL	\$19,605,449	\$14,222,597

Table 1

Hours

While the original contract budget did not include consulting and subcontractor hours, the contract was modified to allow those hours to be used toward the fulfillment of the specified level of effort. As mentioned above, with the anticipated addition of Option 5 hours, the contract should be able to operate through the end of the defined contract period (November 30, 1995).

Direct Labor

As indicated in the table above, the budgeted direct labor dollars exceed the cumulative-to-date figures; however, consultant services and subcontracts reflect more expenditures than budgeted. Additional consultant services and subcontracts were added because it was more cost-effective for the Government to use consultants and subcontractors rather than to hire direct labor employees.

Fringe Benefits

Since the direct labor costs are less than the direct labor expenditures, the associated fringe benefits are reduced.

Travel/Subsistence

At the direction of NASA, the DSLS has supported many meetings and conferences and incurred travel costs that were not anticipated by the original contract budget. Also, many consultants and subcontractors must travel to carry out their particular tasks; again, these costs were not anticipated by the original contract budget. See the Other Direct Costs explanation for additional information.

Consultant Services

Consultant Services are discussed above under Direct Labor. See the Other Direct Costs explanation for additional information.

Equipment

At the direction of NASA, the DSLS has purchased equipment for direct staff, subcontractors, and consultants for use in direct performance of contract tasks, although those purchases were not anticipated in the original contract budget. However, on August 19, 1993, the NASA Contracting Officer notified USRA that general purpose equipment would no longer be allowed as a purchase under the contract.

Subcontracts

Subcontracts are discussed above under Direct Labor.

Other Direct Costs

In the original contract budget, this category included all costs associated with conferences, workshops, educational short courses, seminars, publications, review panels, awards, general life sciences brochure, and relocation expenses, such as travel, consulting, workshop supplies, and other publication costs. The Other Direct Costs category also included items such as long distance telephone, duplication, reprints, air freight, etc. The monthly 533 report assigns travel costs to the Travel/Subsistence category and consulting costs to the Consultant Services category. Supplies and the other items are reported in the Other Direct Costs category; this explains why Other Direct Costs expenditures are lower than originally budgeted. For those same reasons, the Travel/Subsistence and Consultant Services categories reflect greater expenditures than the original contract budget.

Overhead

The original contract budget for Overhead is higher than the actual overhead expenditures. USRA has established two overhead pools, one for tasks that are carried out "offsite" of the CASS building and another for "onsite" for tasks that are carried out at the CASS facility. These two pools have resulted in an overall savings to the Government.

General and Administrative Fee and Subcontracts and Equipment Fee

The development of a special Subcontracts and Equipment Handling Fee has allowed for Subcontracts and Equipment to be charged at a rate lower than the General and Administrative Fee. As indicated in Table 1, this special fee has resulted in a considerable savings to the Government.

Facilities Capital Cost of Money

In accordance with Cost Accounting Standards 414 and 417, and FAR 31.205-10, USRA has included facilities capital cost of money (FCOM) associated with the acquisition of the new facility (CASS).

Management Fee

Fee dollars earned are based on total level of effort hours expended, which includes direct labor, consultants, and subcontracts that are not level of effort.

Program Income

The Program Income category includes registration fees and other moneys collected that have offsetting costs included in one or several of the categories above.

Overall, after the exercise of Option 5, there should be adequate contract value to support this effort through the end of the contract period. As seen by Figure 2, the 25,000 hours provided by Option 5 should allow completion of the contract.

DSLS Personnel

Director

Alfred C. Coats is a professor in the departments of Otolaryngology and Communicative Sciences and Neurology at Baylor College of Medicine in Houston, Texas. He has authored or coauthored more than 60 papers in refereed journals and has contributed to 15 books. His research and clinical interests are in clinical testing of neurophysiologic function with emphasis

on the inner ear. However, his scientific interests and knowledge span a wide range of topics. He assumed the DSLS directorship in 1991 and currently devotes 50% of his time to the DSLS.

Deputy Director

John R. Sevier first served in a research capacity at NASA's Langley Research Center and later in various engineering and science management capacities at the Johnson Space Center. He chaired the Lunar Traverse Planning Team for the Apollo program and was the Deputy Program Scientist for the Skylab Mission. From 1975-1977 he was Chief of the Integration Division in the Program Operations Office at JSC. He received the NASA Exceptional Service Medal in 1972 and the NASA Medal for Scientific Achievement in 1973. He joined USRA in August 1977 as Associate Director of the Lunar and Planetary Institute (LPI). He served as Acting Director of the LPI in 1979. He has been the Deputy Director of the Division of Space Life Sciences since 1983, and has been the Director of the Division of Educational Programs since 1989. He recently became Director of the Student Explorer Demonstration Initiative (STEDI) - a new program awarded to USRA to manage small, low cost, short-lead time missions to support space science projects by undergraduate and graduate students. Mr. Sevier currently devotes 65% of his time to the DSLS.

Project Manager

Terri K. Jones manages all administrative activities for the DSLS. Her responsibilities include oversight of more than 100 tasks, some of which include subcontract administration, large research conferences, and multiple budgets. She has over 15 years of experience in managing critical administrative areas supporting various types of government contracts. Her last 10 years have been focused on government contract administration and project management. She has a B.S. in Education from New Mexico State University and an M.S. in Public Administration from the University of Texas at Tyler. While serving as the Head of Administration and Facilities at the National Scientific Balloon Facility, she was responsible for the contract management of 11 different facilities contracts for construction for NASA, which accounted for \$4 million of the overall \$78 million contract. As a result of the success of these projects, Ms. Jones was awarded the NASA Public Service Group Achievement Award in May 1994. She devotes 100% of her time to the DSLS.

Support Personnel

The DSLS support team has a wealth of experience in contract administration; conference, seminar and workshop management; visiting scientist recruitment and support; technical writing and editing; and scientific peer review implementation.

The DSLS support team consists of:

Tammie Willy	Project Administrator	100% time
Barbara Railsback	Administrative Secretary	100% time
Kay Nute	Editorial Assistant	80% time
Lisa Reed	Technical Specialist	80% time
Gail Pacetti	Travel and Meeting Coordinator	75% time
Dana Nelson	Accounting Assistant	Indirect

Business Management

Business management of this program is the responsibility of USRA Headquarters, located in Columbia, Maryland. USRA Headquarters provides accounting and contract administration support and oversight for USRA-sponsored programs. Accounting functions are performed under the direction and supervision of Ms. Sheila Del Favero, Chief Financial Officer. Ms. Del Favero is a Certified Public Accountant and holds a master's degree in Management and Supervision, with a concentration in business administration. Ms. Del Favero has over 15 years of experience with USRA.

Contract administration support and oversight functions are under the direction and supervision of Ms. Beverly Johnson, Procurement Officer. Ms. Johnson is a Certified Professional Contracts Manager and holds a master's degree in Business Administration, with a concentration in procurement and contract management. Ms. Johnson has 18 years of experience in procurement and contract management.

SUGGESTED ADDITIONAL EFFORT

Research Awards Program

During the next fiscal year the DSLS proposes to establish the Phillip C. Johnson and D. Stuart Nachtwey Research Awards Program designed to recognize outstanding intramural life sciences research at the Johnson Space Center. It is anticipated that the awards will consist of a suitable plaque and certificate. The process of establishing this awards program will take place as follows:

1. In consultation with JSC life sciences research management, the DSLS will establish award categories and an application and selection award schedule.

2. Applications for the award will be solicited. It is anticipated that these will be made by Medical Sciences Division Branch Chiefs - possibly with the assistance of internal committees composed of Branch personnel. The number and source of applications will depend on the award categories (e.g., "Basic Science" versus "Operational Investigations."). An application will consist of an investigator's CV and a manuscript or published article describing the research.

3. Selection of Awardees:

The DSLS will establish a committee of scientists, drawn from the local academic community and the DSLS Science Council, to judge the entrants. Subject to verification by JSC management, the evaluation and selection process would consist of selecting a small number (e.g., 3-4) finalists and the overall winners.

4. Awards Seminar:

An Awards Seminar presented by the finalists would be a means of introducing the local academic community to the high caliber of life sciences research being carried out at JSC. Therefore, it would be desirable to publicize the seminar throughout the Houston/Galveston area. The Selection Committee would announce the winners at a ceremony held at a later date.

Expansion of Space Life Sciences Consortium

In addition to continuing the Quarterly SLS Consortium Newsletter, the DSLS proposes to engage in an intensified recruitment program with the goal of increasing participation by the end of 1995 by at least five institutions. The recruitment program will begin with a systematic survey of JSC life sciences researchers to obtain listings of institutions with whom they collaborate. Any of these already-collaborating institutions that are not currently consortium members will be invited to join the SLS Consortium. An additional list of potential new

consortium members will be generated from lists of institutions applying independently for grant or contract support.

Expansion of the HRF Visiting Scientists Program

The pilot HRF Visiting Scientist Program has established the basic administrative machinery, including development of promotional materials, generation of comparative data on effectiveness of advertisements in specific journals, establishment of a Selection Committee, and acquisition of experience with the selection procedure. It is proposed that the program be expanded to: (1) increase the number of Visiting Scientist positions to four, (2) allow longer onsite stays, and (3) add a Visiting Consultant position to recruit personnel with highly specialized skills required by sponsoring laboratories.

The promotional program would be significantly enhanced by including, in addition to journal advertisements, the production of a one-page program brochure, which would be mailed to appropriate departments of U.S. medical schools and selected universities. This expanded promotional program should yield an even higher quality and larger applicant pool than was obtained in the pilot program.

APPENDIX I

USRA/DSLS VISITING AND STAFF SCIENTISTS AND CONSULTANTS

Name	Address	Description of Work	Discipline Area
Consultants			
Ariel, Gideon	Ariel Dynamics, Inc. Trabuco Canyon, CA	Develop a new programmable resistive exercise device and validate its operation in terrestrial and microgravity environments.	Exercise Physiology
Benton, Tony	2437 Bay Area Blvd. Houston, TX	Develop inter-communications hardware and software for JSC Bio-technology facility.	Biotechnology
Bondar, Roberta	University of Toronto Toronto, Ontario Canada	Develop and evaluate Transcranial Doppler System and other instruments to simultaneously measure cerebrovascular, neuroendocrine and hemodynamic responses to standing before and after space flight.	Neurology/ Neurophysiology
Brody, Baruch	Baylor College of Medicine Houston, TX	In association with Bioethics Policy Task Force, prepare a policy manual and other documents related to the ethics of human subjects research at NASA.	Biomedical Ethics
Burroughs, Walter	Rockville, MA	Produce Human Physiology in Space high school textbook.	Life Sciences Education
Byrne-Dunhill, Paul	Dallas, TX	Design and develop Gas Locker.	Bioengineering
Chambers, Mike	Allen, TX	Develop PC networking hardware and software for NASA/JSC Biotechnology facility.	Software Development
Clement, Gilles	Laboratoire Physiologie Neurosensorielle CNRS, Paris, France	Investigate the effects of weightlessness on visual-vestibular interactions as coinvestigator of Microgravity Vestibular Investigation aboard IML-1.	Neurophysiology
Crawley, Frank	Austin, Texas	Develop an evaluation process for the <i>Human Physiology in Space</i> textbook demonstration project; collect, organize, analyze, and summarize data.	Life Sciences Education
Foster, Phillip	Annecey, France	Investigate pulmonary mechanics and gas exchange in hyperbaric and hypobaric atmospheres and mechanisms of decompression sickness.	Barophysiology
Jones, Eric	Los Alamos, NM	Produce Apollo Lunar Surface Journal - an annotated transcript of air-to-ground communications during lunar surface operations with commentary emphasizing EVA work experience and human factors issues.	Human Factors
Linenger, Kathryn	Seabrook, TX	Assist in the administration, planning and US-Russian coordination of science activities for Shuttle/Mir Mission, including training and baseline data collection.	Administration
McGrath, Braden	National Aerospace Medical Research Laboratory Pensacola, FL	Develop fluid and structural model of the horizontal semicircular canal system.	Neurophysiology/ Computer Modeling

Merchez-Cheli, Marianne	Brussels, Belgium	Provide consultative and administrative support for integration of US and Russian life sciences research on the Shuttle/Mir Project.	General Life Sciences
Neitzel, Lee	Kemah, TX	Develop software and hardware for computer intercommunication network for the NASA/JSC Bio-Technology Facility.	Software Development
Palasciano, Sam	Fallbrook, CA	Provide consultation and engineering support for development of the Metabolic Gas Analyzer System to be flown on the Shuttle/Mir Mission.	Biomedical Engineering
Parker, Donald	Seattle, Washington	Analyze perceptual report data and develop animation devices to illustrate self-orientation perception and self-motion.	Neuroscience
Peterson, Rob	NASA/Johnson Space Center Houston, TX	Develop "virtual instrumentation" approach to physiological measurements for human space flight. Design, build, and test engineering models of this measurement system.	Physiological Measurement System
Phillips, Robert	Department of Physiology Colorado State Univ. Fort Collins, CO	Provide administrative support for the Chief Scientist serving the Space Station program. Activities focus on the Shuttle-Mir program and International Space Station program.	Administration
Rainbolt, Richard	Allen, TX	Support the development of software and hardware for a computer networking system in the NASA/JSC Biotechnology Facility.	Software Development
Ward, Jon	Dallas, TX	Provide software engineering consultation on development of a computer networking system for the NASA/JSC Biotechnology Facility and development of the Gas Locker.	Software Development
Young, Richard	NASA/Kennedy Space Center Kennedy Space Center, FL	Support NASA Exobiology and CELSS programs through interaction with NASA Headquarters, field centers, national and international advisory committees, and the scientific community.	Exobiology/CELSS

Visiting Scientists			
Beatty, Richard	USRA Office Washington, D.C.	Establish an International Science and Technology Office to facilitate space flight research activities and involve the Russian scientific community in the research program.	Mission Planning/Program Architecture
Biever, Larry	USRA Office Washington, DC	Provide management support for interface between NASA Programs and Flight Missions Branch and NASA Life Sciences Division, including facilitation of Life Science Branch's participation in flight mission planning and development of science and technological requirements documents.	Administration
Cooper, David	NASA/Johnson Space Center Houston, TX	Study lymphocytes in vivo and their response to infection and cancer in an activated state.	Biotechnology and Immunology
Gantenbein, Rex	NASA/Johnson Space Center Houston, TX	Design and develop a flexible, real-time experiment control and data acquisition software system to support human experiments.	Neuroscience/Software Design and Development
Gretebeck, Randall	NASA/Johnson Space Center Houston, TX	Design and conduct ground-based and flight experiments to study the effects of space flight in energy metabolism and body composition.	Nutritional Biochemistry
Lathers, Claire	Albany College of Pharmacy Albany, NY	Conduct research in the autonomic and hormonal mechanisms of cardiovascular adaptation to microgravity.	Cardiovascular Physiology
Lira, Cecelia	NASA/Johnson Space Center Houston, TX	Study lymphocytes in vivo and their response to infection and cancer in an activated state.	Biology/Immunology
Liskowsky, David R.	USRA Office Washington, DC	Provide administrative support for science planning in the neuroscience discipline of the NASA Space Physiology and Countermeasures Program.	Neuroscience/ Administration
Lujan, Barbara	Dallas, TX	Develop and produce high school science textbook entitled, Human Physiology in Space.	Life Sciences Education
Meeks, June	USRA Office Washington, D.C.	Provide administrative support for USRA Visiting Scientists to facilitate their Mission Planning, Neuroscience, and Radiation Biology tasks.	Life Sciences Administration
Raj, Anil	Pensacola, FL	Investigate device that provides motion and orientation information via somatic transducers. Evaluate and implement new eye motion tracking methods.	Neurophysiology
Schimmerling, Walter	USRA Office, Washington, DC	Provide management support for NASA Space Radiation Health and Radiation Biology Research Program.	Radiation Biology/ Administration
von Deutsch, Daniel	NASA Johnson Space Center Houston, TX	Study effects of potential countermeasures to disuse or microgravity-induced muscle atrophy using differentiated primary human muscle cells.	Cell Culture

Williams, Jon	NASA Johnson Space Center Houston, TX	Investigate the role of the sympathoadrenal system and its control of the cardiovascular system in human physiological responses to simulated microgravity (head-down bed rest).	Cardiovascular Physiology
Wolfe, James W.	USRA Washington Office Washington, DC	Provide management support for neuroscience research activities within NASA, including development of science requirements statements for Neurolab.	Neuroscience/ Administration

APPENDIX II

USRA/DSLS RESEARCH SUBCONTRACTS

Principal Investigator	Contracting Organization	Description of Work	Discipline Area
Anderson, D.	U. of Michigan, Ann Arbor, MI	Investigate the effect of microgravity on the vestibulo-ocular reflex and other classes of eye movement (project included in the NASA Microgravity Vestibular Investigation).	Neurophysiology
Berthoz, A.	College de France Paris, France	Support Microgravity Vestibular (MVI) Investigations and complete publications from STS-42 Flight in 1992 (IML-1) on MVI's objective #6: Visual Vestibular Interaction.	Neurophysiology
Black, O.	Good Samaritan Hospital Portland, OR	Investigate effects of microgravity on maintenance of posture and generation of positional nystagmus (project included in the NASA Microgravity Vestibular Investigations Mission Series).	Neurophysiology
Cardus, D.	Baylor College of Medicine, Houston, TX	Develop and evaluate a rotating artificial gravity simulator as a tool for investigating cardiovascular changes in response to varying forces.	Cardiovascular Physiology
Cohen, B.	Mount Sinai Medical Center New York, NY	Construct and test optokinetic apparatus for use in ground-based research on the effects of gravity on optokinetic nystagmus.	Neurophysiology
Clement, G.	MEDES Paris, France	Investigate eye movements of the astronauts during various phases of shuttle missions during voluntary movements of the eye and head.	Neurophysiology
Croston, R.	Ron Croston, Ph.D. and Assoc. Inc. Houston, TX	Develop Payloads Integration Planning System (PIPS) and modules of program integration and a project management concepts which could provide the basis for eventual implementation on related flight projects.	Payload Data Management
Dizio, P Lackner, J.	Brandeis University Waltham, MA	Analysis of data acquired in the MVI experiment performed on IML-1 specifically to analyze the pre- and post-flight data for the pitch runs of FO-1.	Neurophysiology
Dutcher, F.	George Washington University Washington, DC	Develop experiment summary database for NASA Life Sciences Flight Research.	Library Sciences
Guedry, F.	University of W. Florida Pensacola, FL	Investigate problems in dynamic postural control after short orbital missions. Participate in analysis of data from NASA Microgravity Vestibular Investigation.	Neurophysiology
Igarashi, M.	Nihon University Tokyo, Japan	Provide scientific support for NASA Microgravity Vestibular Investigation: Vestibulo-ocular reflex suppression, optokinetic after-nystagmus, and visual-vestibular interaction.	Neurophysiology
Jarmul, E.	University of West Florida Pensacola, FL	Research potential methods of decreasing the incidence of spatial disorientation (SD) accidents in the aerospace community through the use of a man-machine interface, e.g. , vibro tactile stimulation.	Neurophysiology

McEwen, M.	Spaceflight Integ. and Operations	Define and plan implementation of operations and data requirements for life sciences space flight experiments, develop requirements for space craft onboard data handling and ground operations and data handling facility capabilities.	Spaceflight and Ground Data Management
Lackner, J.	Brandeis University Waltham, MA	Provide scientific support for NASA Microgravity Vestibular Investigation: Vestibulo-ocular reflex suppression, optokinetic after-nystagmus, and visual-vestibular interaction.	Neurophysiology
Oman, C.	MIT Cambridge, MA	Investigate vestibulo-ocular reflex function in microgravity and motion sickness (project included in the NASA Microgravity Vestibular Investigation).	Neurophysiology
Pawelczyk, J.	Presbyterian Hospital of Dallas, TX	Study validation and comparison of flight systems for determination of cardiac output.	Cardiovascular Physiology
Pellis, N.	M.D. Anderson Cancer Center Houston, TX	Investigate the effect of microgravity on the ability of lymphocytes to locomote through the intercellular matrix.	Hematology/ Biotechnology
Raphan, T.	Brooklyn College/CUNY	Support NASA's Microgravity Vestibular Investigation (MVI) in studies of optokinetic nystagmus (OKN), optokinetic after-nystagmus (OKAN) and spatial orientation in a large dome environment.	Neurophysiology
Roberts, B.	Futron Corporation	Process and load planning data into Program Integration Management System (PIMS) evaluating the work processes and preparing specifications for improvements.	Program Data Management
Robertson, R.M.	Vanderbilt Univ., Nashville, TN	Investigate the effect of fludrocortisone on the hemodynamic changes caused by bed rest.	Cardiovascular Physiology
Utell, M.	University of Rochester Med. Ctr.	Conduct scientific research planning in the disciplines of toxicology, microbiology and barophysiology.	Environmental Health
Witham, L.	Clarke Consulting Group	Provide cross-cultural training to NASA's Medical Sciences Division on how to work and negotiate with Russians.	Behavioral Training
Scott, J.	Center for Public Service Communications Arlington VA	Develop and implement telemedicine demonstration project.	General Medicine

APPENDIX III

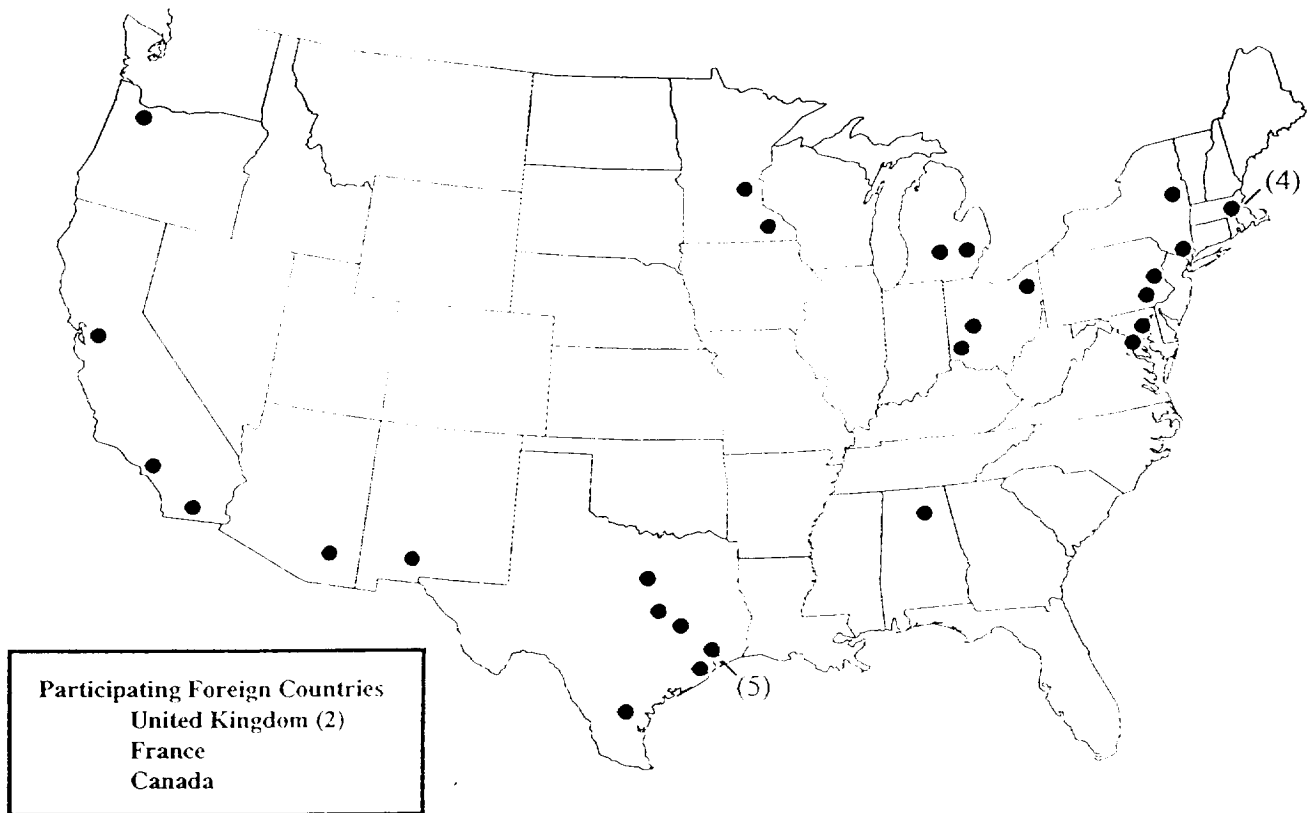
HONORARIA

Name	Address	Description of Work
Iwan Alexander, Ph.D.	University of Alabama Huntsville Huntsville, Alabama	Serve on the Centrifuge Facility <i>Ad Hoc</i> Review Panel, Washington D.C., 5/3-6/94
Shelby Alexander	Grants High School Grants, New Mexico	Coordinate submission of final teacher reviews to <i>Human Physiology in Space</i>
David J. Anderson, Ph.D.	University of Michigan Ann Arbor, Michigan	Serve on the Centrifuge Facility <i>Ad Hoc</i> Review Panel, Washington D.C., 5/3-6/94
Phillip Bishop, Ph.D.	University of Alabama Tuscaloosa, Alabama	Review manuscripts "Changes in muscle mass neural activation and strength performance following space flight" and "Evaluation of resistance exercises of a countermeasure during simulated space flight"
Susan Bloomfield, Ph.D.	Texas A&M University College Station, Texas	Present a seminar "Muscle/bone interactions in the prevention of disuse osteopenia," 8/12/94, NASA/JSC
Kathy Bodner	J. J. Pearce High School Richardson, Texas	Participate in the meeting to review <i>Human Physiology in Space</i>
Pat Brown	Plano High School Plano Texas	Participate in the meeting to review <i>Human Physiology in Space</i>
Brenda Casali	Cimarron, New Mexico	Participate in the meeting to review <i>Human Physiology in Space</i>
Janis Cogswell	S. Grand Prairie High School Grand Prairie, Texas	Participate in the meeting to review <i>Human Physiology in Space</i>
Fran Gratt	Episcopal School District Dallas, Texas	Participate in the meeting to review <i>Human Physiology in Space</i>
James Grissett, Ph.D.	Pensacola, Florida	Assist in program development of the Advanced Technology Demonstration "Tactile interface to improve situational awareness"
Jeanie Harding	R. L. Turner High School Carrollton, Texas	Participate in the meeting to review <i>Human Physiology in Space</i>
Barbara Heck	W. Mesquite High School Mesquite, Texas	Participate in the meeting to review <i>Human Physiology in Space</i>
Ceile Hedberg, D.V.M.	R. W. Johnson Pharmaceutical Research in Laboratory Animal Medicine Raritan, New Jersey	Serve on the <i>Ad Hoc</i> Animal Care and Use Review Panel Meeting in Washington, D.C., 5/31/94
James Huggins	Skyline High School Dallas, Texas	Participate in the meeting to review <i>Human Physiology in Space</i>
David R. Jones, Ph.D.	Aeropsych Associates San Antonio, Texas	Serve as a member of the Bioethics Policy Task Force
Michael Katovich, Ph.D.	University of Florida College of Medicine Gainesville, Florida	Serve on the Centrifuge Facility <i>Ad Hoc</i> Review Panel, Washington D.C., 5/3-6/94
Ralph Lydic, Ph.D.	Pennsylvania State University College of Medicine Hershey, Pennsylvania	Present a seminar "Sleep deprivation, vigilance deficits, and the brain: Relevance for long-term exposure to microgravity," JSC, Bldg. 37, 3/28/94
George McAfee	New Mexico Highlands University Las Vegas, New Mexico	Participate in the meeting to review <i>Human Physiology in Space</i>
Robyn Nishimi, Ph.D.	U.S. Congress Office of Technology Assessment Washington, D.C.	Serve as a member of the Bioethics Policy Task Force

Dega Patterson	Albuquerque, New Mexico	Participate in the meeting to review <i>Human Physiology in Space</i>
Jim Pawelczyk, Ph.D.	Presbyterian Hospital Dallas, Texas	Serve as a science advisor for the development and manufacture of the Gas Analyzer System for Metabolic Analysis Physiology (GASMAP) Shuttle/Mir flight hardware
Chester Pierce, M.D.	Harvard University Cambridge, Massachusetts	Serve as a member of the Bioethics Policy Task Force
Ernest Polansky	Sandia Preparatory School Albuquerque, New Mexico	Participate in the meeting to review <i>Human Physiology in Space</i>
Kim Prisk	University of California, San Diego La Jolla, California	Serve as a science advisor for the development and manufacture of the Gas Analyzer System for Metabolic Analysis Physiology (GASMAP) Shuttle/Mir flight hardware
Louis J. Ramazzotto, Ph.D.	Long Island Jewish Medical Center New Hyde Park, New York	Serve on the <i>Ad Hoc</i> Animal Care and Use Review Panel Meeting in Washington, D.C., 5/31/94
Peter Raven, Ph.D.	University of North Texas Health Science Center Ft. Worth, Texas	Serve as a science advisor for the development and manufacture of the Gas Analyzer System for Metabolic Analysis Physiology (GASMAP) Shuttle/Mir flight hardware
Rex Robinson	Bluewater, New Mexico	Participate in the meeting to review <i>Human Physiology in Space</i>
Harry Rozmiarek, D.V.M.	University of Pennsylvania Philadelphia, Pennsylvania	Serve on the <i>Ad Hoc</i> Animal Care and Use Review Panel Meeting in Washington, D.C., 5/31/94
Kathy Saunders	South Garland High School Garland, Texas	Participate in the meeting to review <i>Human Physiology in Space</i>
Barbara Shykoff, Ph.D.	State University of New York at Buffalo Buffalo, New York	Serve as a science advisor for the development and manufacture of the Gas Analyzer System for Metabolic Analysis Physiology (GASMAP) Shuttle/Mir flight hardware
Richard Simmonds, D.V.M.	University of Nevada Reno, Nevada	Serve on the <i>Ad Hoc</i> Animal Care and Use Review Panel Meeting in Washington, D.C., 5/31/94
Glynn Starr	Truth or Consequences, New Mexico	Participate in the meeting to review <i>Human Physiology in Space</i>
George M. Stancel	Houston, Texas	Participate in a seminar "A common sense approach to grant writing," 1/7/94
Israel Taback, Ph.D.	Newport News, Virginia	Serve on the Centrifuge Facility <i>Ad Hoc</i> Review Panel, Washington D.C., 5/3-6/94
Ron Teeter	Arlington, Virginia	Edit the final copy of <i>Human Physiology in Space</i>
Arthur C. Vailas, Ph.D.	University of Wisconsin - Madison Madison, Wisconsin	Serve on the Centrifuge Facility <i>Ad Hoc</i> Review Panel, Washington D.C., 5/3-6/94
James Wall	Christian Century Magazine Chicago, Illinois	Serve as a member of the Bioethics Policy Task Force
Calvin H. Ward, Ph.D.	Rice University Houston, Texas	Serve on the Centrifuge Facility <i>Ad Hoc</i> Review Panel, Washington D.C., 5/3-6/94
Kim Wootton	Nimitz High School Irving, Texas	Participate in the meeting to review <i>Human Physiology in Space</i>

APPENDIX IV

SPACE LIFE SCIENCES CONSORTIUM



University of Arizona
 Baylor College of Medicine
 Boston University School of Medicine
 Brandeis University
 University of California, Los Angeles
 University of California, San Diego
 Case Western Reserve University
 Centre National de la Recherche Scientifique (France)
 Good Samaritan Hospital & Medical Center
 University of Alabama in Huntsville
 Harvard/MIT Joint Health Sciences Program
 University of Houston, Downtown
 University of Houston, Clear Lake
 Lehigh University
 Los Alamos National Laboratory
 Massachusetts Institute of Technology
 McGill University (Canada)
 Miami University
 Mayo Clinic
 University of Michigan
 Michigan State University

University of Minnesota
 Mt. Sinai Medical Center
 National Institutes of Health
 • National Institute on Deafness & Other Communication Disorders
 • National Institute of Neurological Disorders and Stroke
 • Office of Science Policy and Legislation
 Pennsylvania State University
 RAF Institute of Aviation Medicine (U.K.)
 Rensselaer Polytechnic Institute
 Rice University
 University of Sheffield
 Stanford University
 Texas A&M University System
 Uniformed Services University of the Health Sciences
 University of Texas, Austin
 University of Texas Health Science Center at Houston
 University of Texas Health Science Center at San Antonio
 University of Texas Medical Branch at Galveston
 University of Texas Southwestern Medical Center at Dallas
 Wright State University